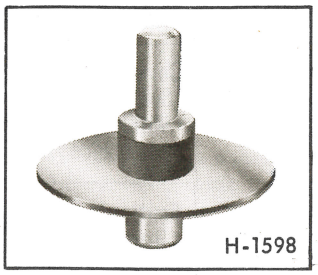
SILICON N-P-N "overlay" TRANSISTOR

For UHF/Microwave Power Amplifiers, Microwave Fundamental-Frequency Oscillators, and Frequency Multipliers



RCA-2N5470* is an epitaxial silicon n-p-n planar transistor employing the overlay emitter-electrode construction. It is intended for solid-state microwave radiosonde, communications, and S-band telemetry equipment.

The ceramic-metal coaxial package of the 2N5470 features low parasitic capacitances and inductances which provide for stable operation in the common-base amplifier configuration. This transistor can be used in both large and small-signal applications in coaxial, stripline, and lumped-constant circuits.

For application information on the 2N5470, see RCA Application Note AN3764, "Microwave Amplifiers and Oscillators Using the New RCA 2N5470 Power Transistor," by G. Hodowanec, O.P. Hart, and H.C. Lee.

*Formerly RCA Dev. Type No. TA7003

FEATURES

- 1-W output with 5-dB gain (min.) at 2GHz
- 2-W output with 10-dB gain (typ.) at 1 GHz
- Ceramic-metal hermetic package with low inductance and low parasitic capacitances

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	55	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With external base-to-emitter resistance (R_{BE}) = 10 Ω	V_{CER}	55	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	3.5	V
PEAK COLLECTOR CURRENT		0.4	A
CONTINUOUS COLLECTOR CURRENT	I_C	0.2	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25 °C		3.5	W
At case temperatures above 25 °C	See Fig. 2.		
TEMPERATURE RANGE:			
Storage and operating (junction)		−65 to +200	°C

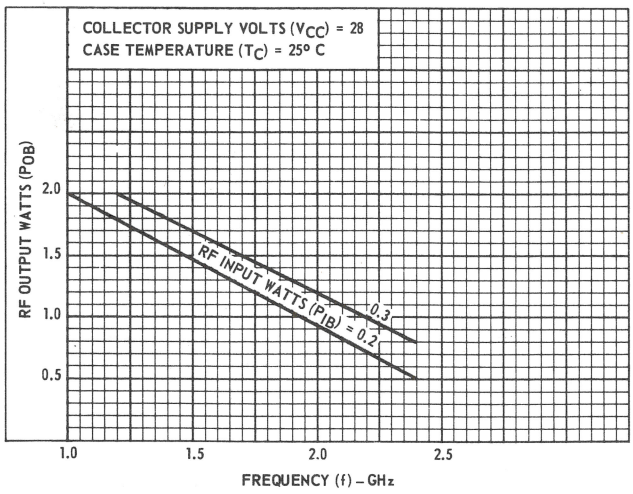


Fig. 1 - Typical Output Power vs. Frequency for Common-Base Power Amplifier

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RCA Electronic Components

Printed in U.S.A. 8/68

ELECTRICAL CHARACTERISTICS *At Case Temperature (T_C) = 25 °C*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS					LIMITS		UNITS
		DC Collector Voltage (V)		DC Current (mA)					
		V_{CB}	V_{CE}	I_E	I_B	I_C	Min.	Max.	
Collector-Cutoff Current	I_{CES}		50		0		–	1	mA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$			0		0.1	55	–	V
Collector-to-Emitter Sustaining Voltage: With external base-to-emitter resistance (R_{BE}) = 10 Ω	$V_{CER(sus)}$					5	55	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$			0.1		0	3.5	–	V
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$				10	100	–	1.0	V
Collector-to-Base Capacitance (Measured at 1 MHz)	C_{cb}	30		0			–	3.0	pF
RF Power Output (Common-Base Amplifier):									
At 2 GHz[a] (See Fig. 5.)	P_{OB}	28					1.0	–	W
At 1 GHz[b] (See Fig. 12.)		28					2.0 (typ.)		W
RF Power Output (Common-Base Oscillator): At 2 GHz (See Fig. 15.)	P_{OB}	24				80	0.3 (typ.)		W

[a]For P_{IB} = 0.316 W; minimum efficiency = 30%

[b]For P_{IB} = 0.20 W; typical efficiency = 50%

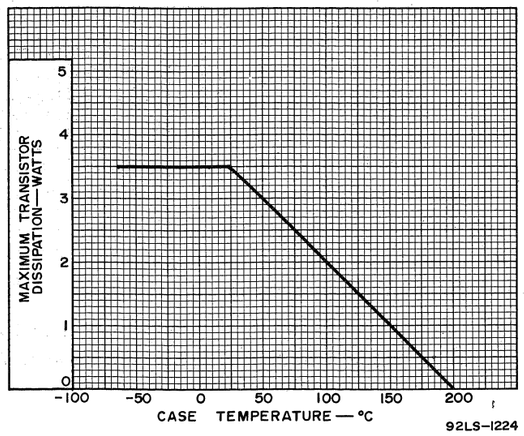


Fig. 2 - Dissipation Derating Curve

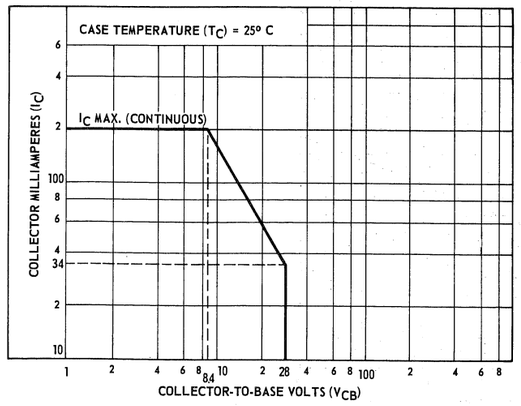


Fig. 3 - Maximum Operating Area for Forward-Bias Operation

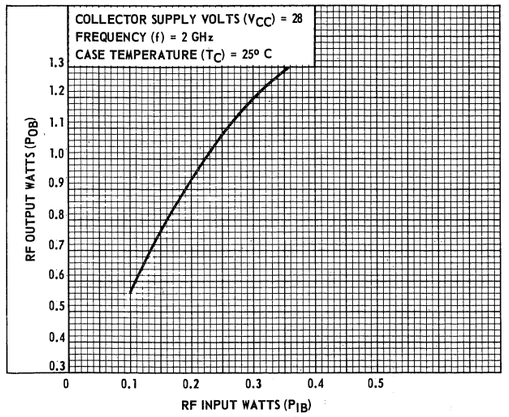


Fig. 4 - Typical Output Power vs. Input Power for 2-GHz Common-Base Power Amplifier

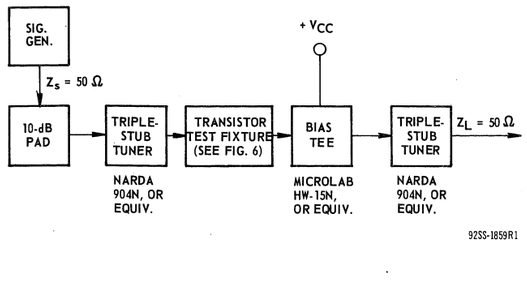
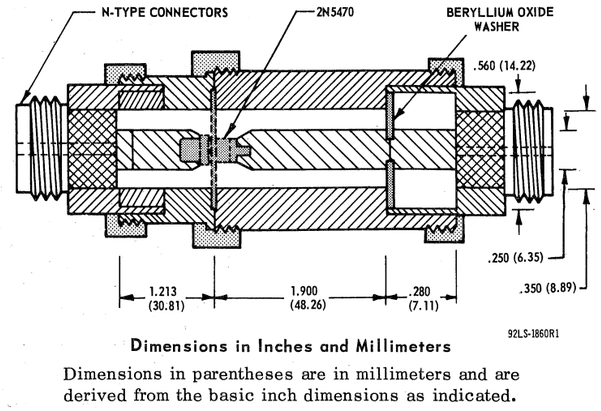


Fig. 5 - Block Diagram of Test Set-up for Measurement of Output Power from 2-GHz Common-Base Amplifier



Dimensions in Inches and Millimeters

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.

Fig. 6 - Suggested Test Fixture for Test Set-Up Shown in Fig. 5.

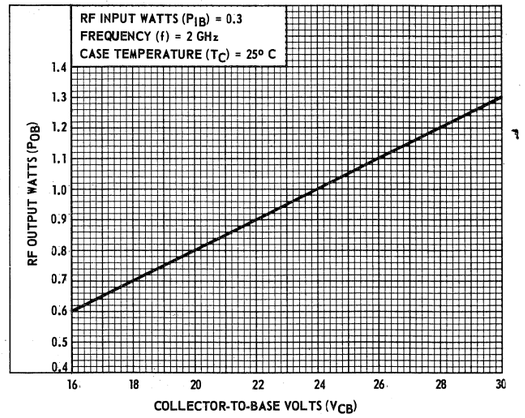


Fig. 7 - Typical Output Power vs. Collector-to-Base Voltage for 2-GHz Common-Base Power Amplifier

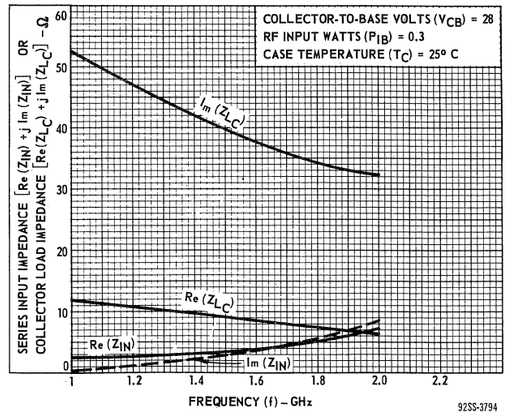


Fig. 8 - Typical Series Input Impedance and Collector Load Impedance vs. Frequency for Common-Base Power Amplifier

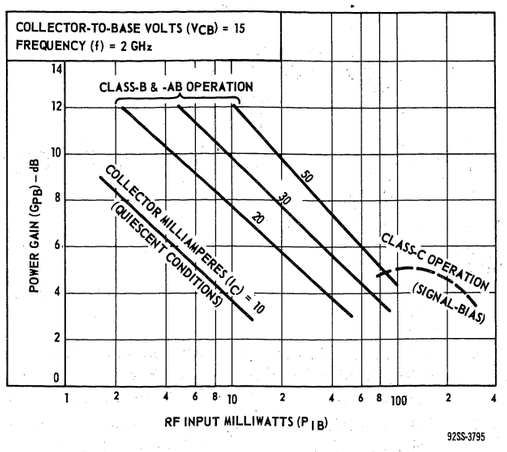
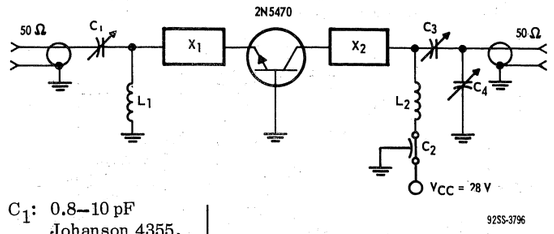


Fig. 9 - Typical Power Gain vs. Input Power for 2-GHz Common-Base Power Amplifier



C_1: 0.8–10 pF Johanson 4355, or equivalent

C_2: 1,000 pF, feed-through, Allen-Bradley FB2B, or equivalent

C_3: 0.3–3.5 pF Johanson 4701, or equivalent

C_4: 0.35–3.5 pF Johanson 4702, or equivalent

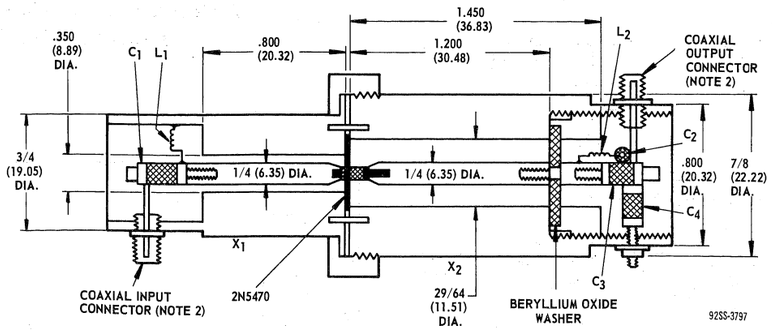
L_1, L_2: RF choke, 3 turns Nc. 30 wire, 1/16 in. (1.57) ID 3/16 in. (4.75) long

X_1, X_2: Coaxial lines; see Fig. 11 for details.

Dimensions in Inches and Millimeters

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.

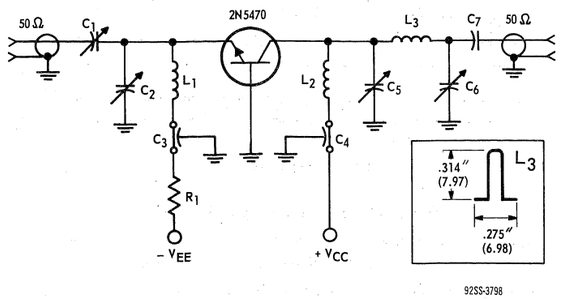
Fig. 10 - Typical Circuit for 2-GHz, Coaxial-Line Power Amplifier Shown in Fig. 11.



Note 1: Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.

Note 2: Conhex 50-045-0000, Sealectro Corp., or equivalent.

Fig. 11 - Constructional Details of 2-GHz Power Amplifier Shown in Fig. 10.



C_1, C_5, C_6: 1–14 pF, air-dielectric, Johanson 3901, or equivalent

C_2: 0.35–3.5 pF, air-dielectric, Johanson 4701, or equivalent

C_3, C_4: 1000 pF, feed-through, Allen-Bradley FA5C, or equivalent

C_7: 1000 pF, ceramic, leadless

L_1, L_2: RF choke, 0.1 μH, Nytronics Deci-Ductor

L_3: 0.01-in. (.254) thick, 0.157 in. (3.98) wide copper strip shaped as shown in inset drawing

R_1: 100 Ω, ½ W

Dimensions in Inches and Millimeters

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.

Fig. 12 - Typical Circuit for 1-GHz Power Amplifier

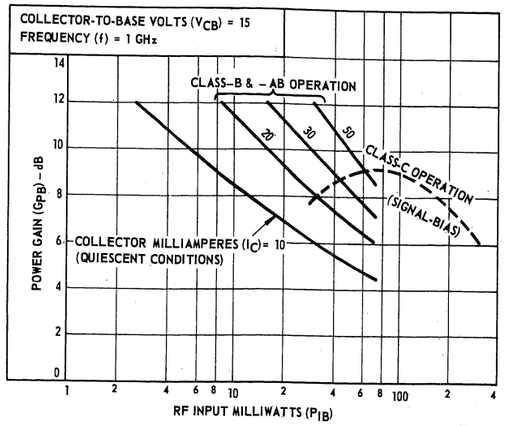
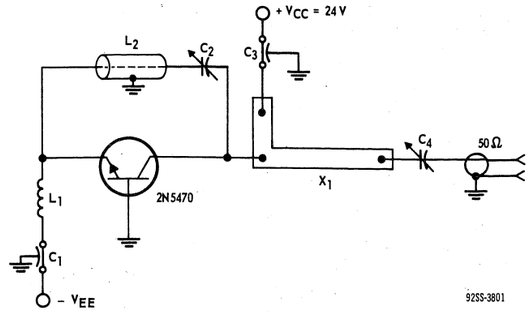


Fig. 13 - Typical Power Gain vs. Input Power for 1-GHz Power Amplifier



C_1, C_3: 100 pF, feed-through, Allen-Bradley FA5C, or equivalent

C_2, C_4: 0.35–3.5 pF, Johanson 4702, or equivalent

L_1: RF choke, 5 turns No. 33 wire, 1/16 in. (1.57) ID, 3/16 in. (4.76) long

L_2: 50-Ω miniature coaxial line 1.5 in. (38.1) long

X_1: Microstripline circuit; see Fig. 16 for details.

Dimensions in Inches and Millimeters

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.

Fig. 15 - Typical Circuit for 2-GHz Grounded-Base Power Oscillator

C_1: 0.01 μF disc ceramic

C_2, C_3: 100 pF, feed-through, Allen-Bradley FA5C, or equivalent

C_4, C_5: 0.35–3.5 pF, Johanson 4701, or equivalent

L_1, L_2: RF choke, 4 turns, No. 33 wire, 0.062 in. (1.57) ID, 3/16 in. (4.75) long

L_3: 3/64 in. (1.17) length of No. 22 wire

X_1: 0.82 pF, "gimmick", Quality Components type 10% QC, or equivalent

R_1: 5–10 Ω, 1/2 W

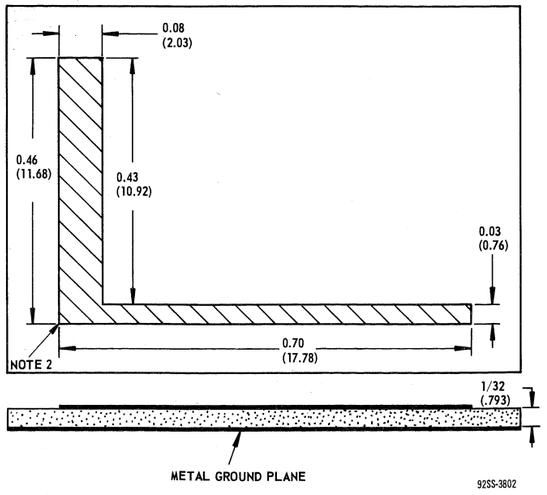
R_2: 51 Ω, 1/2 W

R_3: 1200 Ω, 1/2 W

Dimensions in Inches and Millimeters

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.

Fig. 14 - Typical Circuit for 2-GHz Grounded-Collector Power Oscillator



Dimensions in Inches and Millimeters

Note 1: Dimensions in parentheses are are in millimeters and are derived from the basic inch dimensions as indicated.

Note 2: Produced by removing portion of upper layer of double-clad, Teflon board, Budd Co. Polychem Div. Grade 108T, 1 oz, 1/32 in. (.793) thick, (ϵ = 2.6), or equivalent.

Fig. 16 - Detail Drawing of Microstripline, X_1 Specified in Fig. 15.

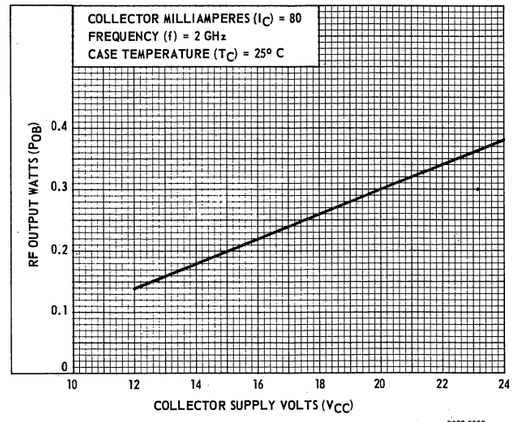
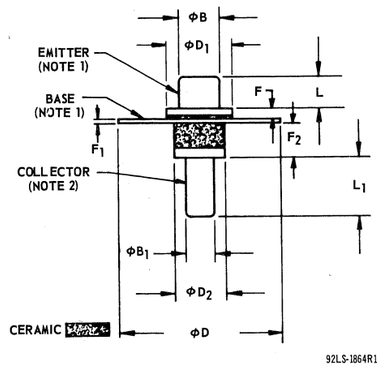

COLLECTOR MILLIAMPERES (I_C) = 80
FREQUENCY (f) = 2 GHz
CASE TEMPERATURE (T_C) = 25° C
RF OUTPUT WATTS (P_{OB})
COLLECTOR SUPPLY VOLTS (V_{CC})
92SS-3803

Fig. 17 - Typical Output Power vs. Collector Supply Voltage for 2-GHz Grounded-Base Power Oscillator

DIMENSIONAL OUTLINE



SYMBOL	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
ΦB	.118	.122	2.997	3.098
ΦB_1	.090	.094	2.286	2.387
ΦD	.497	.503	12.624	12.776
ΦD_1	.180	NOM.	4.57	NOM.
ΦD_2	.162	NOM.	4.11	NOM.
F	.046	.055	1.168	1.397
F_1	.009	.011	.229	.279
F_2	.114	.124	2.90	3.14
L	.099	.103	2.515	2.616
L_1	.179	.191	4.55	4.85

NOTES:

1. Gold-plated KOVAR*
2. Solid silver

* Trademark, Westinghouse Electric Corp.